

Simon Yorke Designs

precision
analogue disc transcription
system

Professional Archive Turntable - PAT2

designed and built for the US National Library of Congress

PAT2-06

The Professional Archive Turntable assembly consists of 10 major parts:

1. Stand.
2. Baseplate.
3. Module.
4. Bearing.
5. Platter flywheel.
6. Platter surface plate.
7. Record mat(s).
8. Armboard.
9. Tonearm(s).
10. Motor and motor drive system.

Operating Instructions specific to the Professional Archive Turntable PAT2 System:

There are four pushbutton switches on the motor power supply unit (MPSU) fascia.
Their operating parameters are as follows:

LOCAL/COMPUTER speed, direction and action will be determined manually by the switch settings on the MPSU fascia / or by RS232 computer serial interface.
(N.B. During RS232 operation, all manual controls are bypassed.)

CW/CCW determines direction of rotation (in manual mode only).

STALL/RUN determines run or stall condition (in manual mode only)

NOT AT SPEED INDICATOR ONLY - illuminates when unit not running at the speed indicated by the manual thumbwheels or requested by serial interface.

POWER ON/OFF power supply switch for the entire motor control system

Manual operation of the unit:

The unit will have been calibrated before shipment and may thus be operated manually without further ado. Excluding a few very specific functions which are not essential to operation of the unit, the turntable may be used without connection to a p.c. - containing all those functions necessary for basic operation.

To instigate manual operation of the unit, proceed as follows:

1. Connect the unit to a mains voltage supply.
2. Switch on the unit using the power on/off switch.
3. Switch the unit to INTERNAL control.
4. Set the drive switch to STALL.
5. Select CW or CCW direction.
6. Set the thumbwheel switches to the chosen setting (between 10.00 and 120.00).
7. Set the drive switch to RUN.

The turntable should accelerate to speed and, once attained, the tracking indicator lamp should go off. The unit is now running correctly and platter speed may be checked using a stroboscopic disc or an external tachometer.

Notes:

If the selected thumbwheel settings are outside the nominal prescribed range of the unit then the turntable will run as fast (or slow) as it is able but the tracking indicator lamp will remain illuminated to indicate that the motor is unable to achieve the selected speed. Reset the thumbwheels to within the 10.00-120.00 range permitted.

If any of the limit or fault indicators illuminate, a fault condition exists and the unit should be reset to default by momentary removal of the supply voltage.

Computer operation of the unit:

The unit may be connected to a p.c. using the trailing 9-way-"D" RS232 serial link which exits from the MPSU rear panel.

To operate the unit from a p.c., proceed as follows:

1. Connect the serial link cable to a p.c.
2. Set the control switch to EXT (this bypasses all other switch settings).
3. Boot up the p.c. into DOS.
4. At the DOS cursor, type **PROCOMM** (or other RS232 command language)
5. **Enter**
6. **Enter**.
7. Type **1QA** (the p.c. monitor will scroll the default settings of the unit).
8. To set the speed for clockwise rotation at 33,33 rpm, type **1RPM-3333** and **enter** (unit will show ok).
9. To set the speed for counter-clockwise rotation at 33,33 rpm, type **1RPM3333** and **enter** (unit will show ok).
10. The unit should run at the selected speed.
11. To stall the unit, type **1ST**.

Other specific commands, relating to motor velocity and its coefficients, may be found in the PM600 manual supplied with the turntable. These commands are not typically needed for general operation of the unit but may be accessed by reference to that manual. Unless some very specific motor control parameters are needed, these additional commands should not be required, the default settings being sufficient for general operation.

to calibrate the unit for speed:

For speed calibration, the unit must first be connected to a p.c. RS232 serial port as described previously. Then proceed as follows:

1. Place a stroboscopic disc on the turntable
2. Set the unit to EXT control mode.
- 3a. Type **RPM-3333** and **enter** (for clockwise calibration at 33,33 rpm). OR:
- 3b. Type **RPM-7800** and **enter** (for clockwise calibration at 78.00 rpm).

NB: If the MPSU echoes back a return digit to the host computer (for example, producing a "QQ" where a "Q" was typed), use the **Alt+E** command to rectify.

Visually check on the stroboscopic disc that the unit is rotating clockwise at exactly the right speed. If so, no further action is needed. If not, proceed as follows:

5. Type **1QSCL** and **enter** (the p.c. monitor will show a four-digit number).
6. Type **1SCAL** followed by a number slightly larger (or smaller) than the number indicated to increase (or decrease) the speed, and **enter**.

The unit will run slightly faster or slower, as directed. Continue with this process until the unit is running at the correct speed. To retain the last SCAL figure in the MPSU's ROM, following withdrawal of mains power, type **1BD** and await an "OK".

Please note that, though very little, speed calibration may be affected by increased or decreased drive cord tension. So, it's a good idea to check that the distance between the motor housing and platter flywheel remains constant; the nominal distance is 255mm from turntable centre to motor centre (105 mm from the edge of the platter flywheel to the motor centre) when utilising the supplied translucent poleurethane drive cords. The speed calibration should be checked from time to time, in any event.

Notes:

At each command, the p.c. monitor will show **OK** if the command is attainable. Any command that is outwith the unit's ability will be indicated accordingly. Momentarily remove mains power from the MPSU to effect a reset from an unwanted latched condition. A soft stall can always be attained by invoking an **ESC** command.

It is not possible to speak to the MPSU via a p.c. unless the unit is set to EXT.

Whilst in EXT control mode, the direction and run switches are inoperative.

Return to manual mode may be instantly attained by switching to INT at any time.

Computers sometimes have nervous breakdowns, like us. Should the unit fail to respond to instructions, whether in INT or EXT mode, it will be necessary to reset the unit to its default condition. Do this by switching to EXT control mode and type **1IN** (initialise). This should return the unit to normality. Please note that the speed calibration may be disturbed during this procedure and it will be necessary to check and possibly recalibrate accordingly.

Other control parameters may be accessed via the p.c. interface. These are not generally required for nominal operation of the unit and should only be utilised if the operator is p.c. literate and fully aware of the procedures invoked. Consult the PM600 manual thoroughly to ascertain if such parameter changes are advisable.

Operating the unit in Constant Linear Velocity (CLV) mode:

Switch the turntable to **EXT** control and hook up to a p.c. Using the procomm address system, establish a link with the turntable (follow the instructions given in the operating manual) and try this:

Let's assume you have a disc which you wish to have a start speed of 33.33 rpm and a terminal speed of 45.00 rpm. The acceleration factor, given in steps per second at the motor, is entered by the **1SA** command.

type **1RPM-3333** (for clockwise motion); the turntable will run at 33.33 rpm.

type **1SA200** (to give an acceleration rate of 200 steps/sec.)

type **1RPM-4500** (to determine the chosen terminal speed)

You can now listen to the steady rate of acceleration.

Once you have established the correct starting speed, it should be relatively easy to establish the correct terminal speed. Simply enter these speeds (as per example given above) and try different figures for **1SA** until you get what you're looking for. I would presume that once you've found a practical value for **1SA**, all your CLV discs will require the same treatment.

Please note that the default value for **1SA** is **10,000**.

When you enter p.c. control of the turntable, type **1QSCL**; the **1SCAL** figure given, when multiplied by the **RPM** figure, gives the constant velocity (**1SV**) in steps/sec. at the motor.

Therefore, **SV = RPM x SCAL x 100**.

The formula for calculation of acceleration rate is as follows:

$$a - b / SA = t$$

where a = terminal speed
 b = starting speed
 t = time taken from b to a in seconds.

for further guidance:

for 33.33 rpm, SV = 17,700 approx.

for 45.00 rpm, SV = 24,000 approx.

for 78.00 rpm, SV = 41,500 approx.

Installation of the turntable:

1. Take the turntable stand, complete with 19" sub-rack and motor platform, and place it upon the chosen operating platform.
2. Loosely affix the motor cylinder to the motor platform using the M6 x 25 socket bolt supplied.
3. Take the baseplate and position it symmetrically above the turntable stand.
4. Place the turntable module in the center of the slate baseplate and orient the unit such that the nameplate faces to the front (and the earthing screw to the rear).
5. Affix the armboard (counterbore side up) using the three M6 x 20 cap screws supplied. The principal tonearm position on the armboard should point to the rear and right of the turntable (NE), at an angle of 30 degrees from a left/right centre line. Tighten the armboard fixing screws until they begin to 'bite' and no more. Do not overtighten these screws - nothing will be gained except damage to the armboard.
6. Check that the two thrust balls (one in the bearing housing and the other in the bearing shaft end) are held securely in their centres - a little grease in the ball pockets will help retain the balls.
7. Add 2.25ml. fine machine oil to the bearing reservoir before inserting the bearing shaft. Press the bearing shaft slowly down, until it bottoms, and wipe off any overspill of oil from the armboard surface. If no oil is ejected from the bearing housing, add more oil until the bearing housing is completely flooded and insertion of the bearing shaft causes excess oil to be ejected. Please note that the bearing housing **must** be completely flooded with oil at all times - inadequate flooding of the bearing will cause friction levels to increase and optimum results from the unit will not be attained. Allowing the bearing shaft to descend slowly (rather than being forcibly pressed down) should ensure correct flooding of the bearing assembly. Now remove any oil overspill from armboard surface (**this is important**).
8. At this point it is advisable to ensure that the preferred record spindle is affixed to the bearing shaft flange. The interchangeable (6mm diameter root) record spindles are locked to the bearing shaft flange by a recessed M3 socket set screw.
9. Gently lower the platter flywheel onto the bearing shaft flange, taking great care not to inflict any torsional force upon the bearing.
10. Add a record mat - or if discs larger than 12" diameter are to be played first add an appropriate surface plate - then the chosen record mat.

11. Affix the tonearm(s) and complete all the relevant alignment parameters (see following pages).
12. Connect the blue and red motor power leads to the amplifier motherboard with the blue wire in M1 and the red wire in M2. Connect the encoder to the PM600 controller motherboard into the second connector from the top, on the left (looking from rear of rack). Connect the RS232 serial link socket to a p.c. - using the trailing serial interface cable which exits from the rear of the PM600 controller motherboard.
13. Finally, connect the MPSU to the ac power supply - having first checked that the motor power supply is labelled for the correct mains voltage supply - if not, do not switch on but call for assistance.
14. Loop the two drive cords around the motor drive pulley and the lower two grooves of the turntable platter.
15. Select INT and set the thumbwheel and CW/CCW direction controls as desired.
16. Switch on the power at the mains outlet and at the right-hand 'power' switch.
17. Switch the stall/run switch to RUN and ascertain that the unit accelerates without difficulty and locks on to the correct fixed speed and in the chosen direction. If this does not happen, consult this manual further and then, if the problem still cannot be corrected, myself directly.

Further Information:

Don't try and lift the entire turntable assembly under any circumstances - it will do awful damage to your spine.

The turntable is heavy because it is constructed almost exclusively from Austenitic (non-magnetic) Stainless Steel. Do not drop any turntable parts on your foot - such carelessness is unlikely to damage the turntable but will do serious damage to your foot.

Don't try and lift the turntable by gripping the armboard. Lift using the module rim only - the armboard will be damaged otherwise.

Do not allow the armboard to become wet at any time. The armboard should only be dusted with a dry cloth and, perhaps, a little dry polish.

Tensioning of the drive cords: the basic objective is to establish a tension which generates maximum torque with minimum start-up time, but without holding the platter in a vice-like grip which would be sonically constricting. One bolt affixes the motor cylinder to the platform at the rear of the turntable stand. The slot facilitates adjustment of drive cord tension by enabling motor position to be manipulated. The recommended distance between turntable centre and motor centre is 255mm. It may be easier, however, to adjust drive cord tension by either manipulating the module or sliding the motor platform

Drive cords: The platter drive cords are ultrasonically-welded mouldings of a specific polyurethane polymer. These drive cords have greater longevity than their equivalent neoprene types and are able to transmit greater torque. It is recommended to replace the drive cords every few years.

The drive cords will stretch with age but the adjustable nature of the motor drive system means that drive cord life can be extended simply by moving the motor further from the platter, or vice-versa.

Exposure to ultraviolet light and ozone will shorten the life of the drive cord polymer (along with old age) so don't expose the turntable to either if you can help it. Multiple spare drive cords are not included with the equipment because of the natural ageing process - it is best to purchase replacement drive cords when necessary (from a fresh polymer batch).

Oil: It is **essential** to keep the bearing assembly fully flooded with clean oil at all times. A high quality, clear and non viscous oil is optimum. Don't use thick, viscous and exotic oils under any circumstances: these are overly expensive, might possibly attack the bearing bush linings and cause all manner of difficulties.

The Tonearm(s)

Installation of a tonearm:

1. Take the tonearm mounting plate and loosely affix it to the turntable arm-board using the M3 x 25 machine-screws supplied. The output connector bracket should be simultaneously mounted directly below the tonearm mounting plate such that the signal output sockets face to the rear of the turntable.

2. Slide the pivot assembly into the mounting plate, correctly locating the vertical slot with the height-locking set-screw. Do not adjust either of the 3mm set-screws in the pivot sleeve - these are factory set in the optimum position. The pivot centre should be positioned exactly 295,6mm from the turntable centre - the template supplied will establish the correct position: place the template over the record spindle and move the mounting plate assembly inward until the pivot shaft is located against the hole shoulder. Now tighten the mounting plate bolts securely.

PLEASE EXERCISE GREAT CARE WHILST HANDLING THE PIVOT ASSEMBLY - THE PIVOT POINT COULD CAUSE SERIOUS INJURY IF HANDLED STUPIDLY.

3. Orient the cue/bias platform until the bias-assembly-end faces toward the left of the turntable (due West) then tighten the central locking set-screw.

4. Affix a cartridge to the headshell assembly using the M2,5 fasteners provided.

Please note that the cartridge mounting screws also tension the headshell with respect to the tonearm beam so do not over-tighten these screws or damage may occur to both tonearm and cartridge. Because of the additional tension required of these mounting screws, it is perhaps inadvisable to rely on the strength of any cartridge mounting threads alone, but to back-up any such threads with a supporting nut. Please only use M2,5 mounting screws - nothing else is appropriate.

5. Electrically connect the cartridge using the following code (assuming connection for a standard stereo microgroove disc):

RED	RIGHT CHANNEL LIVE	usual code: Red
BLACK	LEFT CHANNEL LIVE	White
BLUE	RIGHT CHANNEL GROUND	Green
YELLOW	LEFT CHANNEL GROUND	Blue

6. Take the tonearm assembly and lower it gently onto the pivot, ensuring correct location. If location is incorrect, movement of the tonearm will be obviously difficult and insecure. The white ptfе ring (which provides a low-friction sliding bearing for the pivot guide plate) should be located in the centre of the pivot guide plate.

7. Place a disc on the turntable and adjust the tonearm geometry as follows:

A. **Vertical Tracking Angle:** The tonearm beam should lie exactly parallel with the disc surface. With the stylus resting on the disc surface (an approximate downforce will first need to be set) raise or lower the pivot assembly until this parallel condition is obtained, then lock the height-adjusting screw firmly. The small parallel-lined template supplied will assist with this alignment.

NB: It should be noted that some cartridges sound better with a different VTA - i.e. with the base of the tonearm slightly higher or lower than here described. The optimum vertical tracking angle will only be found by dynamic experimentation, using your own ears.

B. **Stylus Overhang** is set by moving the headshell assembly back and forth along the tonearm beam, before locking it in position by tightening the cartridge-mounting screws. The correct overhang may be found by using the template supplied: simply set the stylus to follow the radial line printed on the template.

C. **Cartridge Offset Angle** is primarily determined by the fixed mounting holes in the headshell assembly and should not require other than minimal adjustment. The offset angle is directly related to stylus overhang and should be visually checked at the two nulling points indicated on the template. There is sufficient freedom for movement of the cartridge mounting screws to enable minor adjustments to the cartridge offset angle: just twist the cartridge body until its edges are parallel with the lines indicated on the alignment template - then check stylus overhang again.

D. **Cartridge Azimuth** should be set simultaneously with stylus overhang. Azimuth should be correct when the cartridge body is exactly parallel with the disc surface. The small parallel-lined template supplied will assist with this alignment.

E. **Stylus Downforce** is adjusted by sliding the counterweight back and forth along the counterweight beam. Adjust the counterweight until a satisfactory downforce is obtained (follow the cartridge manufacturers' recommendations) and firmly lock the counterweight set screw. Downforce can only be accurately calibrated by using a precision stylus downforce gauge. A variety of cartridge masses and downforce settings may be accommodated by using different counterweights or combinations.

F. **Anti-skating Force:** With the tonearm in the 'at rest' position, loop the bias thread around the guide pin and onto the bias screw. Adjust the bias weight(s) until a satisfactory bias force is obtained (this can only be carried out dynamically whilst the stylus is tracing a revolving record). The uncut surface of the run-out spiral is a good place to initially set the bias force: move the bias weight(s) until the natural tendency of the arm to swing inward is counteracted and the stylus pulls neither inward nor outward but tries to stay in one place.

N.B. Much of the preceding advice assumes that the cartridge manufacturer has geometrically set the stylus and generator assembly exactly square in the cartridge body. This is often not the case. You should therefore be prepared to spend a significant amount of time setting up and aligning the tonearm and cartridge accurately - it will be time well spent.

Electrical installation procedure:

8. Slip the tonearm signal output cables through the central 6mm hole in the connector bracket and make appropriate connections with the output sockets. Try not to "bunch" the wires together as this may restrict free movement of the tonearm.

9. Connect the whole assembly to a phono-preamplifier input via an appropriate cable set. You may, or may not, need to connect the earth drain wire - this depends upon overall system earthing arrangements. Find the arrangement which generates the least residual hum throughout your playback system. I recommend utilisation of a sound earthing wire from both turntable and tonearm to a quality, non a.c. ground.

10. Make a lovely cup of tea, take a great record and enjoy the wonderful world of analogue all over again.

If, having carried out all of the instructions given here, the tonearm does not function satisfactorily, please contact myself directly for assistance. Do not tamper with or modify any aspect of the tonearm - this will invalidate the guarantee.

Further information:

Lift/Lower Mechanism: To raise the tonearm, the cueing lever should be lifted upward into the vertical position. To lower the stylus onto a disc, the cueing lever should be depressed forward and downward until the lever is horizontal. When raised, the stylus should rest about 5-8mm above the disc surface - adjustment can be made by loosening off the small set screw in the cueing beam body, and raising or lowering the lifting beam, or the entire cueing mechanism may be raised or lowered by adjusting the height of the whole cue/bias platform. It is not necessary to add oil or any other lubricant to the cueing mechanism - this has already been done. The mechanism should require no maintenance at any time, though the rubber lip on the cueing beam may be wiped with a mild detergent solution to restore its tack if contaminated by oil or dust.

Bias Assembly: The purpose of an anti-skating force is to counteract the natural tendency for the tonearm to swing inwards and over the centre spindle. This action is attributable to the overhanging nature of the stylus and is an unavoidable aspect of any pivoted tonearm. The bias assembly applies a counteracting force. It should be noted that the skating tendency of the tonearm is not constant across the whole disc surface. It is best to initially set the anti-skating force for optimum response nearest the inner groove radii. Later experimentation will confirm whether or not this initial setting will need to be revised. Bias adjustments can only be set dynamically, whilst the tonearm is tracing a record. Using the ear to detect tracing distortion is probably the only truly satisfactory method of setting the bias force correctly. Should the bias wheel 'stick', a small drop of lubricating oil on the wheel journal should help.

Tonearm Wiring. The tonearm tube is wired with four strands of silver-plated copper wire, sheathed in a ptfе (Teflon) coating. This choice of wire was made with due consideration to both sound quality and flexibility. A unipivot tonearm, by its nature, prohibits the tonearm wire from exiting through the bearing centre - cable flexibility is thus an important issue as an inflexible wire will impede free movement of the tonearm. Very small gauge wiring may be more flexible, though often at the expense of sonic constriction and mechanical fragility. The chosen wire has a powerful and clean sonic signature and, providing care is taken to ensure that its routing to the connector assembly does not impede tonearm movement, will provide both good sound quality and mechanical integrity (very fine wires are easily broken, involving intricate re-soldering operations of a irritating nature). As the tonearm tube is sealed at both ends, and internally damped, rewiring of the tube will not be possible. Please therefore take care not to break any of the wires.

Surface Finish: All the surfaces of the tonearm have been stress-relieved and satin-finished. The aluminium parts are NOT anodised because the anodising process forms a thin but very hard layer of aluminium oxide on the metal's skin. Whilst this anodic film helps protect the basemetal from corrosion and scratches, it also creates a 'hard edge' to the 'sound' of the tonearm. For me, this is an unacceptable compromise. I

have therefore chosen to protect the metal with a film of soft wax (a natural anodic skin will develop in time anyway), leaving the acoustic properties of the tonearm uncompromised, if not improved. Furthermore, anodising can only be successfully employed where the basemetal is a high-purity aluminium - such aluminium is also very soft and therefore structurally ill-suited to use in an application such as this. Alloying of the aluminium with other metals to create a high-strength material, therefore, often precludes the possibility of later successful surface anodising.

The stress-relieving process applied to the tonearm further inhibits a successful anodising treatment by interfering with the electron flow necessary for a high-quality clear anodised finish.

For these reasons, special care should be taken whilst handling the tonearm not to scratch the delicate surfaces.

Output Cable: The Output Cable carries the very small signals from the tonearm to the phono amplifier. This cable should be of a larger gauge than the internal tonearm wiring. The connector bracket is typically fitted with two high-quality insulated RCA phono sockets, permitting a standard phono-to-phono cable set to be used. This arrangement allows experimentation with different cable sets to be made with ease. Please note that although the RCA phono connector is essentially an unbalanced connector, the insulated configuration of the connector plate socketry permits a quasi-balanced mode of operation without the need for complex (and expensive) non-standard balanced cable sets. As some systems (and listeners) are more cable-sensitive than others, final choice should always rest with the individual user. An earthing drain wire may or may not require to be run from the phono amplifier ground terminal to the ground terminal on the tonearm connector plate - this will depend entirely upon the overall earthing arrangement of the individual system. A drain wire connected in this way will effectively earth the entire tonearm assembly and may also be routed to the turntable module body to earth the entire turntable assembly, too.

Tonearm Geometry: This Series 7 tonearm utilises a geometry and mounting system compatible with the well-known SME tonearms. Specifications are as follows:

	9" model	12" model
Distance from tonearm pivot to stylus tip:	233.2 mm	308.8 mm
Distance from tonearm pivot to turntable centre:	215.4 mm	295.6 mm
Cartridge offset angle:	23.64 deg	17.63 deg
Overhang:	17.8 mm	13.2 mm
Inner null radius:	66.0 mm	66.0 mm
Outer null radius:	120.9 mm	120.9 mm

CERTIFICATE OF PROVENANCE




ITEM: Precision Analogue Disc Transcription System
Professional Archive Turntable - PAT2

NUMBER: PAT2-06

DATE OF COMMISSION: January 20th, 2006

I CERTIFY THAT THIS ITEM IS THE ORIGINAL WORK OF SIMON
YORKE, AND WAS CONCEIVED, DESIGNED AND HAND-CRAFTED
BY ME.

SIGNED: 

DATE: 20/01/06

ORIGIN: CDT

S74 - 211

S70a - 238 (12")

Guarantee:

This equipment is guaranteed to operate faultlessly, ad infinitum. If you experience any difficulties please contact me directly for advice and/or assistance. Excepting damage inflicted through careless handling or operation, all necessary servicing or replacement parts will be supplied free of charge (excluding all freight charges, where applicable).

Please look after this equipment: keep it clean, free from excess dust and ultraviolet light, and maintain adequate clean oil in the bearing. Treated thus, and with appropriate respect, this equipment should provide a lifetime's listening pleasure. Running the unit from an incorrect voltage supply or without adequate lubrication in the bearing will invariably damage the unit and must be avoided.

If you have any comments to make concerning the design or operation of this equipment, I would be pleased to hear from you - user feedback is essential in the developmental process of any product. Please write or fax the address given below.

Finally, thank you for buying this product. I hope it brings much pleasure over many years and helps save us from the eternal damnation that is digital audio.

Simon Yorke Designs

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Whilst this manual and these specifications are presented in good faith, I reserve the right to make changes or modifications wherever and whenever I deem either appropriate or necessary.